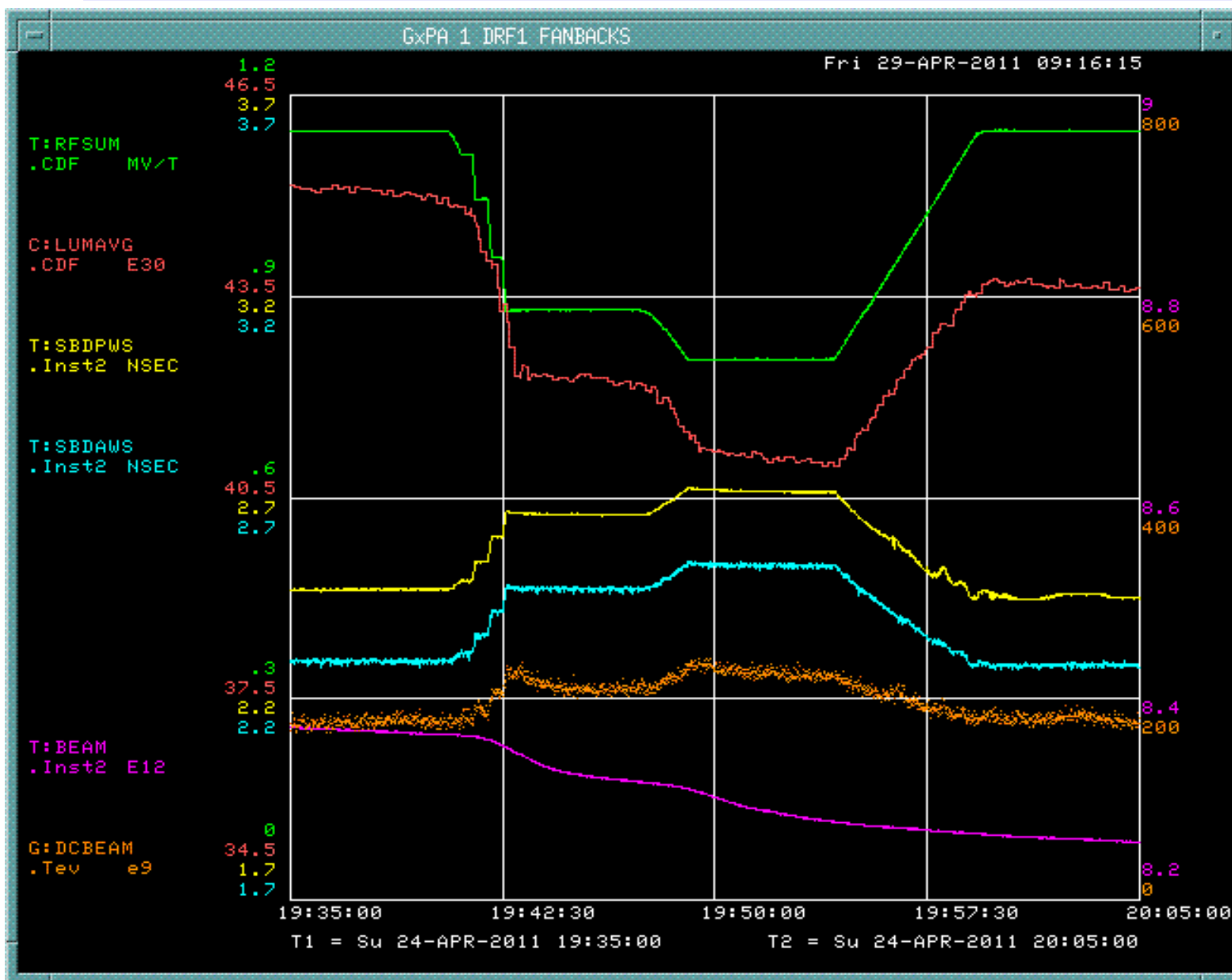# Test of Lumi-Leveling via Bunch Length

End of Store 8692
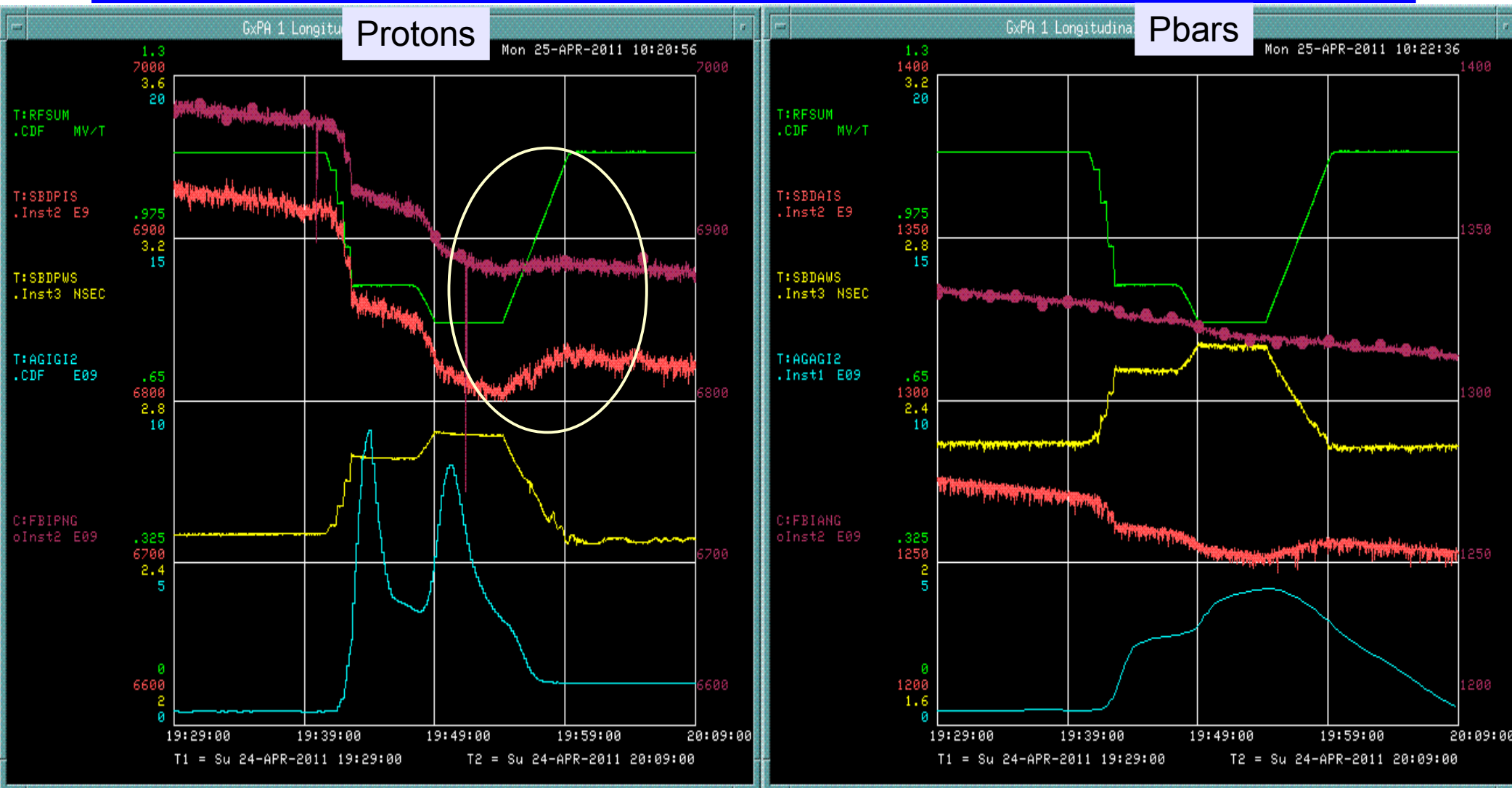
Executive Summary

RF reduced 30%

Lumi dropped ~8%

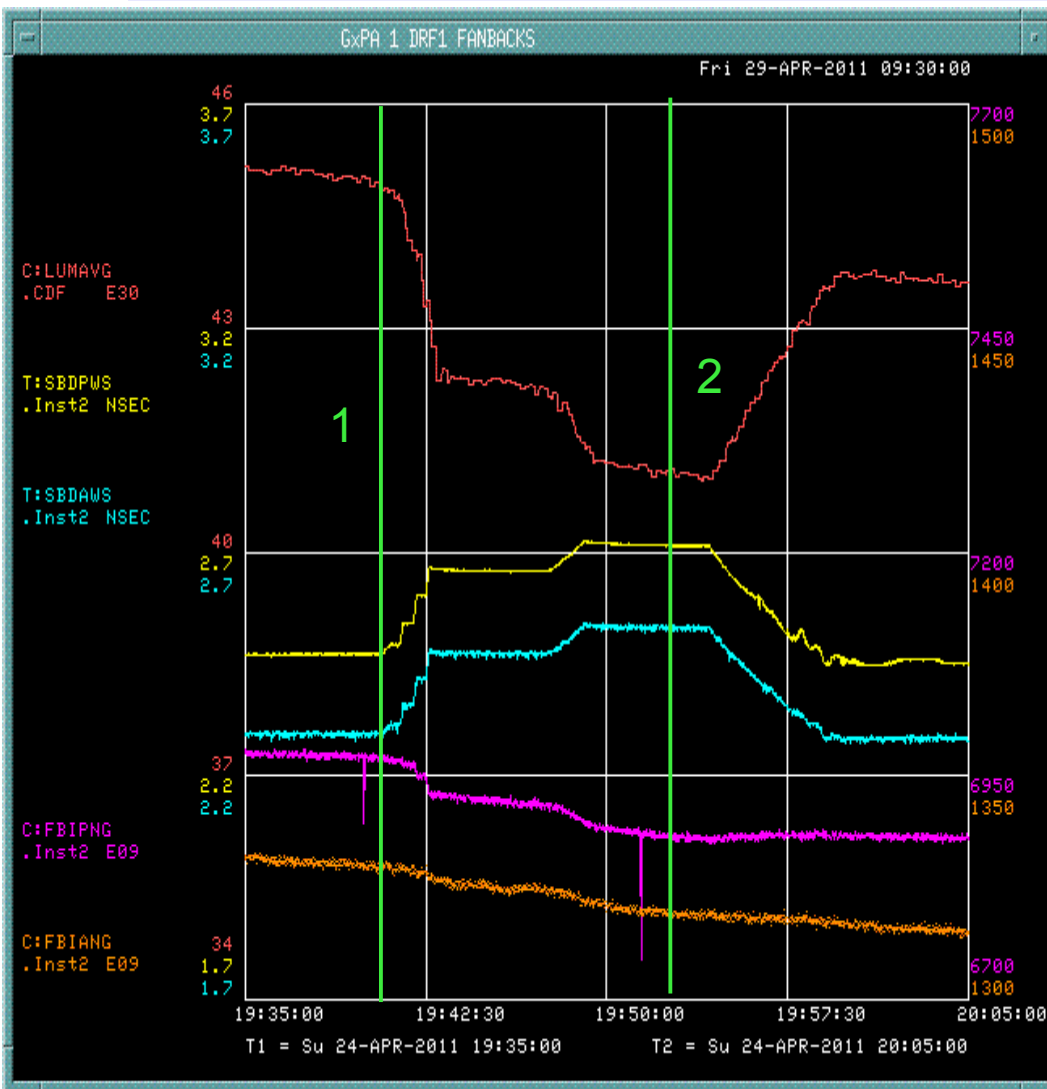Lost beam (protons)

Generated DC beam

FBI & SBD Intensity Change vs RF

- Use FBI intensities for calculations (less variations vs RF)
- Note jumps in abort gap intensities (sync light) as bunch lengths lowered

Calculating Lumi Drop

Ratio of lumi =

Observed lumi drop = 8.5%

Expected Lumi Drop

RF VOLTAGE DROP ≈ 30% (1→2)

USE FBI FOR INTENSITIES → LESS VARIATION VS RF THAN SB

$$\frac{\Delta \mathcal{L}}{\mathcal{L}}(1 \to 2) \approx 8.5\%$$

$$\frac{\mathcal{L}_2}{\mathcal{L}_1} = \frac{N_{p2} N_{a2} H_2}{N_{p1} N_{a1} H_1}$$

ASSUM
∼U CHA
IN EM

→ HOURGLASS (

USING MY MATHCAD β^* SHEET...
↳ 28 cm

$H_1 = 0.469$

$H_2 = 0.440$

ASSUMING
GAUSSIAN
BUNCHES

$$\frac{\mathcal{L}_2}{\mathcal{L}_1} = \frac{(6884)(1319)(0.440)}{(6970)(1330)(0.469)} = 0.919 \Rightarrow 8.1\% \text{ DROP}$$

↓

COMPARE TO 8.5%

Ratio of luminosities at 2 points

Take into account change in hourglass factor & beam loss

- Neglecting any transverse emittance growth (<0.5% from sync light)
- Assuming bunches are Gaussian longitudinally (must have tails)
- Using $\beta^* = 28$ cm to calculate hourglass factor
  - Using $\beta^* = 30$ cm → 7.9% drop (small difference)
- Good agreement between expected and observed: ~8.0% vs 8.5%

Summary

- End-of-store 8602, lowered RF voltage 30%, good agreement between expected and observed luminosity drop

- Beam lost from buckets (protons) caused jumps in DC beam
    - Not unexpected due to long bunch lengths late in store

- Before trying at start of store, want to test mid-store (bunch lengths ~2.0 ns) lower RF voltage, gradually raise over few hours